Bayonne, New Jersey
GENERAL DYNAMICS FIRE

National Fire Coordination Study

U.S. DEPARTMENT OF AGRICULTURE/FOREST SERVICE/DIVISION OF FIRE CONTROL

GENERAL DYNAMICS
FIRE

Bayonne, New Jersey

A study of a specific fire, and a projection of the threat to life and resources had it occurred during a nuclear attack.

A working paper by:

J. H. Dieterich, USFS

and

J. W. Crowley, Research Consultant
System Sciences Company

August 1965

Reviewed by:

W. R. Moore

J. W. Jay

This report was prepared by the U. S. Department of Agriculture, Forest Service, Division of Fire Control, National Fire Coordination Study, Washington, D. C. for the Office of Civil Defense under contract OCD-PS-64-229.

ACKNOWLEDGEMENTS

The Hon. Hugh E. Greenan, Director, Department of Public Safety, and the Bayonne Fire Department were especially helpful in providing reference material and background information on the fire. Chief John J. Momot and Chief Leo F. Smith accompanied the study team to the scene of the fire for on-site briefing and discussion of fire suppression problems.

Mr. James A. Mullanapy, Acting Civil Defense Director in Bayonne, provided fallout shelter data as well as helpful counsel concerning the CD role in handling local disasters.

CONTENTS

FIGURES

TABLES

GENERAL DYNAMICS FIRE

INTRODUCTION

The study of large fires in urban areas, and in areas where the settlement pattern is mixed urban and rural, is an important part of the National Fire Coordination Study. These studies are designed to search out factors important to better utilization of Federal, state, local, and private fire organizations in effective control of fires resulting from natural causes or from an enemy attack.

Most peacetime fires in urban areas are not entirely representative of the fires that might result from an enemy attack. Nevertheless, peacetime fires provide a realistic set of circumstances for evaluating what might be accomplished through the efforts of an organized fire service, and what the ultimate threat might be to the people and resources in the immediate area where the fires occur. A similar study has been completed for four large fires in the Boston area.[1/]

1/ Boston Fires, by J. H. Dieterich and David B. Gratz, NFCS, U. S. Forest Service, June 1965.

One of the major findings in the Analytical Report[2/] was that fire would be a significant causative agent in the loss of lives and resources in a nuclear attack. With the population in residences, fire would be of less significance because a large percentage of the people would lose their lives as a result of blast and fallout. Conversely, with shelters available and being used, more people will survive the immediate effects of blast and the longer term effects of radioactive fallout, but would be threatened by the fires that would result from the thermal effects of the weapons or the secondary ignitions caused by blast damage.

With these considerations in mind, it was decided to study the General Dynamics Fire that occurred in an industrial section of Bayonne, New Jersey, and assess the fire in terms of what could be learned and applied to the objectives of the National Fire Coordination Study.

Figure 1 is an aerial view of the industrial complex destroyed by fire showing point of origin, wind direction, and burned residences and factories.

2/ Analytical Report, by W. R. Moore, J. W. Jay, and J. H. Dieterich, NFCS, U. S. Forest Service, March 1965, classified "CONFIDENTIAL"

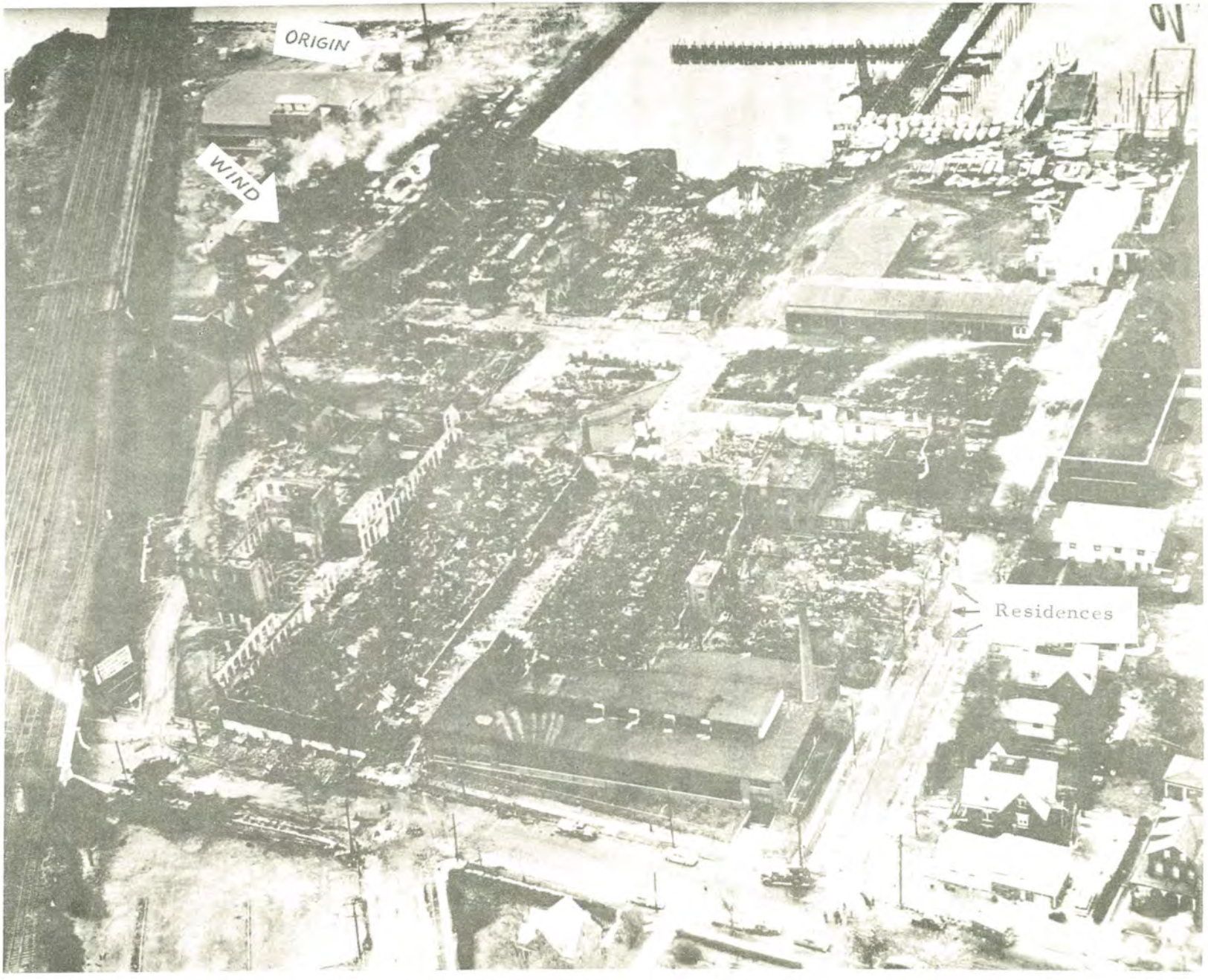

Figure 1: Aerial view showing destroyed industrial complex. (Photo Courtesy Bayonne Fire Department)

OBJECTIVES

The objective in studying the General Dynamics Fire was to utilize the case history of this fire disaster to make meaningful projection of the fire threat to people and resources in an urban area under a simplified nuclear attack assumption. More specifically, the following points were considered:

1. What effective fire suppression action could be accomplished in a one-hour period before critical radioactive fallout arrived?
2. What is the fire threat to a sheltered population in areas adjacent to the fire?
3. Would multiple ignitions caused by the thermal flash create a situation that could be handled in the first hour — handled at all?
4. Would evacuation be possible or desirable under the assumed conditions of attack?
5. How far would the fire be expected to spread before being stopped by natural barriers?
6. Could fire control priorities be established to limit fire development in certain areas?

DESCRIPTION OF BAYONNE AND FIRE POTENTIAL

Bayonne is located on a peninsula extending out into New York and Newark Bay. The Kill Von Kull River separates the city from Staten Island on the south. The population at the time of the 1960 Census was 74,215.[3/] The city is chiefly important as an oil refining and distributing center. Other important industries include manufacture of shipping cases, radiators, insulated wire, cable, drugs, and edible oils.

The type of construction and layout of the buildings and streets of Bayonne, New Jersey, cause a very large portion of this city to be a potential conflagration area. The principal factors leading to this conclusion are:

1. High density of construction. -- The proportion of ground area covered by buildings throughout most of the city is very high. Both residential and commercial areas are congested. Building lots are very small with only 5 to 10 feet side separation between homes, almost no front gardens, and with small rear yards cluttered with garages, sheds and fences. Although the residential area in the northeastern section of the city is slightly more

---

3/ Report on Bayonne, N. J. by National Board of Fire Underwriters, March 1955, Supplement Feb. 1962.

spacious, the city has no suburbs since it is surrounded by water on three sides and joins Jersey City directly on the other. There is a limited area of light industry on the southern and southwestern waterfront and a large tank farm in the "Hook" peninsula on the southeast. Naval facilities exist on the east.

2. Lack of fire breaks. --Within the city there is a distinct scarcity of open areas or wide boulevards which might serve as fire breaks. The wide elevated New Jersey Turnpike crosses the northeast border of the city and should prevent fires from spreading between Jersey City and Bayonne, but no road within Bayonne itself is wide enough to be considered a fairly-certain firebreak. The widest avenue is only 125 feet between building fronts, and the very numerous side streets have building front separations of only 50 to 75 feet. There are virtually no empty lots in the residential or commercial areas due to the scarcity of land within the city. There are some open areas along the waterfronts, and parkland on the northwestern region but none of these open areas serve to alleviate the potential conflagration nature of the city. The New Jersey Central Railroad track provides a break between a small residential section of the city on the south and the larger part to the north.

3. Combustible type of construction. --Most of the buildings in Bayonne are quite old, even the commercial structures, and are generally of wood construction. Except for isolated new home construction, a few institutional buildings, and some new multi-story public apartment buildings on the extreme south and north sides of town, there is almost no fire resistive construction in Bayonne. Most residential housing is two-story frame, sometimes faced with light asbestos siding, and most have typical composition roofing. Some of the homes are in rather poor repair which would add to the fire hazard.

The city has a major urban renewal proposal under consideration at the present time. If this proposal passes, a several-block area of commercial establishments will be demolished and reconstructed. This will provide a better measure of fire protection for a relatively small part of the city.

The NBFU Report on Bayonne (previous footnote) describes the conflagration hazard as follows:

> "In the principal and minor mercantile districts, low building heights and fairly good accessibility are features mitigating against the spread of fire, but with the many groupings of both frame and fire-resistively weak ordinary construction, together with the general lack of automatic sprinklers and other private fire protection, severe group fires are probable, which could easily be swept by the frequent high winds to involve a large section of any of these districts."
>
> Concerning residential areas; "Severe group fires are probable among the closely-built residential buildings which are generally of frame construction."

ASSUMPTIONS

The following assumptions were used in projecting this fire into conditions that might prevail during a nuclear attack:

1. Actual weather conditions experienced at the time the fire occurred would prevail.
2. One hour of firefighting time is available before critical levels of radioactive fallout arrived.
3. Mutual aid is available - also projected without mutual aid.

4. All available shelter spaces are occupied when the fires occur.

5. Fire services are in an increased state of readiness and have called in off-duty firemen.

FIRE DESCRIPTION AND ANALYSIS

General

The General Dynamics Fire occurred on April 20, 1963, during a period of critical fire weather throughout most of New Jersey. Twenty-six industrial buildings and three frame dwellings were either extensively damaged or totally destroyed in a 6 hour period between 2:00 and 8:00 pm.[4/] The fire threatened a large area of residences downwind as strong winds spread the fire from the point of origin through an industrial complex that includes a plastic company, the Electro Dynamic Division of General Dynamics Corporation, and the Englander Mattress Company.

The main fire was stopped at Avenue A and Schryler Court (See Figure 2) although spot fires occurred at several locations downwind from the main fire.

4/ Report of Industrial Area Fire, Bayonne New Jersey Fire Department, April 1963.

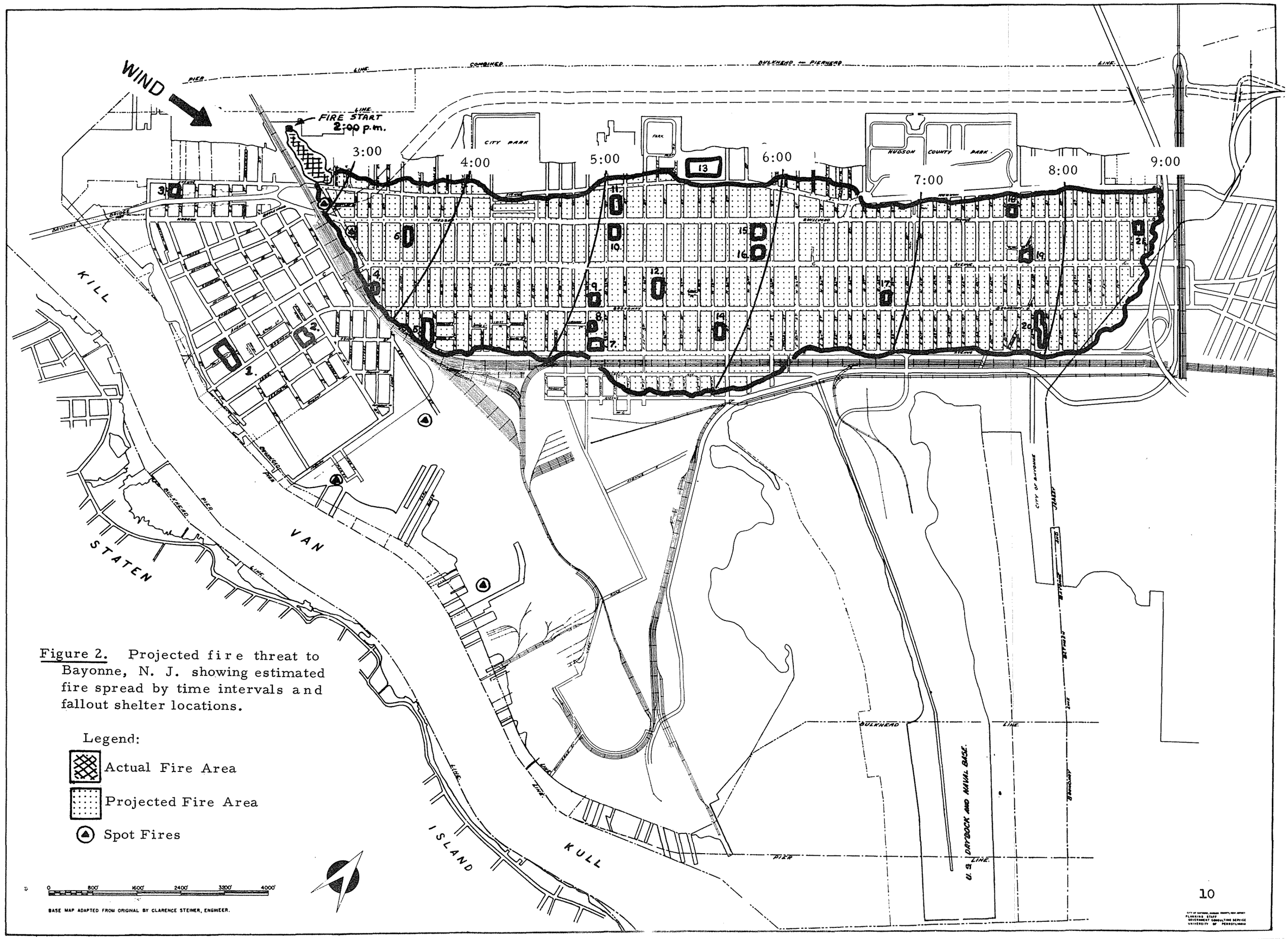

Figure 2. Projected fire threat to Bayonne, N. J. showing estimated fire spread by time intervals and fallout shelter locations.

Legend:

- Actual Fire Area
- Projected Fire Area
- Spot Fires

The following statements emphasize the severity of the weather on April 20th.[5/]

> "It is evident that weather conditions such as prevailed in New Jersey on April 20, 1963, occur at rare intervals - probably no more than 2 spring days and 6 fall days in 50 years.
>
> "At no time did all the elements of fire danger combine to create conditions so severe as those on April 20, 1963."

A similar statement follows:[6/]

> "The driest spring on record in New Jersey culminated for fire protection personnel on the week of April 20-21, 1963, when a series of wildfires burned over 183,148 acres of woodland, 186 homes and 197 outbuildings, and was responsible for the loss of 7 lives."

Several situations developed during the course of the fire that were significant to this particular study:

1. Topography had an effect on the spread of this fire. The exposed buildings in the path of the fire were on progressively higher ground, thus increasing radiation exposure.
2. There were many combustible roofs in the industrial complex and these contributed to the difficulty of control. Sprinkler systems in the buildings were ineffective in controlling these outside fires.

5/ The Forest Fires of April 1963 in New Jersey Can Point the Way to Better Protection and Management, by W. G. Banks and S. Little, Proc., Society of American Foresters, Boston, 1963.

6/ Effectiveness of Prescribed Burning in Reducing Wildfire Damage During Periods of Abnormally High Fire Danger, by J. A. Cummings, Jour., of Forestry, August 1964.

3. Newark Bay was an important water source for pumping equipment. Tank trucks drafted from the Bay and the two New York fire boats pumped over 5,000 gallons of salt water per minute to check the spread of fire to the Englander Matress Company and the nearby boat marina. Drafting water for fire control purposes is a well established practice and develops according to need. Chief Momot stated they could draft water "clear across town" if needed.
4. The water supply system in one of the plants received supplemental pressure from an electric pump. When the fire interrupted the powerlines, plant hydrants and sprinkler systems became ineffective because of insufficient pressure.
5. The intensity of the fire and total envolvement of the buildings prompted a decision by the top command to concede the loss of the industrial area and concentrate on confining the fire and checking the spread to adjacent residences.
6. Several spot fires were started in a wide area downwind from the fire. (See Figure 2) Only one caused major damage to a dwelling. Police Radio Patrol Cars prevented a major expansion of these fires by notifying Fire Headquarters, who in turn dispatched fire companies covering vacant fire stations.

7. Mutual aid fire companies assisting the Bayonne Fire Department included units from Bayonne Naval Base, U. S. Coast Guard, Jersey City, Elizabeth, West New York, Weehawken, Newark, New Jersey, and New York City.

Fire damage was estimated at around $8 million. There were injuries but no loss of life.

Shelters

Figure 2 shows the location of 21 major shelter facilities having a rated occupancy of 33, 304. Other minor shelter facilities are available but not indicated on the map.

The Bayonne Civil Defense Office hopes to identify 80, 000 shelter spaces in the area to handle the permanent population and those working in the area.

Several semi-isolated elementary schools would provide some degree of protection, but these buildings, like the public apartments with basement shelters, would need to be protected both from without and within if fire threatened the building. Depending on the weather at the time, the buildings with combustible roofs might be seriously threatened by spotting even if they were in relatively large open areas.

Some of the shelter facilities are open on two or three sides but close to combustible dwellings on the other sides. Depending on wind direction fire spread from a single building could expose the entire shelter.

The type of construction and age of the shelter facility has a direct bearing on its fire susceptibility. More recent construction may utilize metal window frames, fire resistant roofing, and a minimum of combustible furnishings. Older buildings have wooden window frames, wood trim and combustible materials in the rooms and halls.

Fire Threat

Considering the weather that prevailed at the time, and the industrial character of the area where the fire started, it seems unlikely that this fire could have been controlled within the assumed one-hour time available. As the fallout level increased to a critical level, the fire service personnel working on the fire would need to seek shelter protection so that they would be available to help with subsequent recovery operations. At this point the fire services personnel might proceed to pre-assigned shelters to direct the efforts in shelter fire protection.

With the termination of control action by the fire services, the fire would continue to spread. An attempt to predict the extent of fire spread, by one hour intervals, might indicate a pattern roughly similar to the shaded area in Figure 2. These spread predictions are based on a report summarizing actual rates of spread on 23 urban fires.[7/] The report indicates that it is not unreasonable to expect rates of spread that approach 1/2 mile per hour - especially when weather is critical, the buildings are predominately wood, and building density is medium to heavy (20-39% of total ground area occupied by buildings).

As mentioned earlier under "Firebreaks", the streets would be inadequate to stop the spread of fire with the wind and with no control action. The New Jersey Central Railroad right-of-way would help isolate the part of town south of the tracks and reduce the threat to shelters in that area. It is difficult to predict the effectiveness of the railroad right-of-way as a fire break along the southeastern edge of the city; but if there were combustible fuels across the track, the fire would undoubtedly be a threat to structures and resources in that area.

7/ Prediction of Fire Spread Following Nuclear Explosions, by C. C. Chandler, T. G. Storey, and C. D. Tangren. Research Paper PSW-5, 1963, Berkeley, Calif.

Spreading at an average rate of approximately 1/2 mile per hour, the fire would have been approaching the New Jersey Turnpike, separating Bayonne and Jersey City, by approximately 9:00 pm. During the projected course of this fire, some of the shelter buildings would be heavily involved; other shelters could perhaps be adequately protected from fire using a trained brigade and some shelters might be only threatened due to location and more fire resistant construction. Table 1 summarizes some general information on the 21 shelter facilities shown in Figure 2. While these shelter facilities were not evaluated closely from the standpoint of fire protection from within, we were able to determine a relative protection rating based on building construction and spacing. This table shows that all but Shelter Facility No. 13 would be threatened by fire, and of the 21 facilities only 5 had a protection rating of good. This means that these five facilities would likely survive the fire with the help of a trained shelter fire protection crew; the shelters having a fair and poor protection rating would probably have a difficult time surviving even with trained protection forces working from within.

In summary then, it is estimated that at least 17,723 of the 33,304 occupied spaces would probably survive the fire, and if shelter fire protection efforts were successful in other shelter facilities, the number of survivors would be increased.

Table 1

FALLOUT SHELTERS - CAPACITY AND FIRE THREAT

Shelter No.	Building Use and Type of Construction	Spacing Characteristics		Shelter Capacity	Protection Rating **	Predicting Fire Threat (If industrial fire had been uncontrolled)	
		Min.	Max.			Is shelter in an area predicted to burn?	If yes, is shelter threatened by fire?
1	Apartments, Public Housing, 4-Story Brick	15'	100	1,053	Fair	No	-
2	St. Andrews School, New 2-Story Brick	100	100+	665	Good	No	-
3	Plastics Plant, Industrial Area, Old 4-Story Brick	50	100+	901	Fair	No	-
4	City Hall Annex, 3-Story Stone Office Bldg.	5'	100+	317	Poor	Yes	Yes
5	Garden Apts., 5-Story Brick with Wood Frame Windows	100	100+	350	Fair	Yes	Yes
6	School #12, 3-Story Brick, Wood Frame Windows	100	100+	850	Fair	Yes	Yes
7	Industrial YMCA, 3-Story Brick	80	100+	1,770	Fair	Yes	Yes
8	Mt. Carmel School, 3-Story Brick	25	50	608	Poor	Yes	Yes
9	Office Building, 5-Story Brick	3	75'	854	Poor	Yes	Yes
10	Assumption School, 3-Story Brick	10	150'	1,700	Poor	Yes	Yes
11	School #11, 2-Story Masonry	150	150+	418	Good	Yes	Yes
12	School #2, 4-Story Brick	25	100'	1,385	Poor	Yes	Yes
13	Bayonne High School, Large 3-Story Brick Complex of Buildings, Wood Windows	75	150+	11,300	Good	Yes	No
14	Hospital and Nursing Home, 6-Story Brick	100	200'	2,600	Fair	Yes	Yes
15	School #3, 3-Story Brick, Tile Roof, Frame Windows	50	300	2,602	Good	Yes	Yes
16	Bayonne Library, 2-Story Brick and Masonry	15'	300'	1,241	Good	Yes	Yes
17	School #6, 3-Story Brick, Metal Windows	75	300	1,640	Fair	Yes	Yes
18	School #13, 3-Story Brick	75	100+	2,162	Good	Yes	Yes
19	Apartments, 4-Story Brick	75	150	230	Poor	Yes	Yes
20	Apartments, 3 to 7-Story Brick	100	100	477	Fair	Yes	Yes
21	School (Woodrow Wilson) 3-Story Brick, Wooden Windows	100	250	181	Fair	Yes	Yes

* This sample of fallout shelters in Bayonne include the major facilities as far as shelter capacity is concerned.

** Good: 100+ feet on all sides, fire resistant construction
Fair: 75-100 feet on all sides, some combustibles
Poor: Less than 100' spacing on 3 sides, some combustibles

OBSERVATIONS

1. There are no low building density suburbs in Bayonne, thus adequate home fire protection should accompany home shelters. Providing fire protection for homes during periods of fallout would be difficult.
2. Fire service personnel and responsible city officials seem to be fully aware of the combustibility of their city and recognize the hazards associated with radioactive fallout.
3. Multiple ignitions caused by a thermal flash would probably develop into so many fires that control within the first-hour would be impossible.
4. The fire services have no specific plans for dealing with the nuclear fire problem although they are well prepared for radiological monitoring. They would welcome guidance and assistance in helping to prepare a plan that could be activated in a wartime emergency.
5. Evacuation of Bayonne would be difficult since the city is surrounded on three sides by water. The Bayonne Bridge on the S. W. and the New Jersey Turnpike on the N. E. are the two major exits.
6. There appears to be a good working relationship between fire and police officials, the public safety director, and Civil Defense officials.

7. Bayonne and Jersey City both utilize hose thread adapters so that they can use each other's equipment during mutual aid situations.

CONCLUSIONS

1. Fire weather was an important factor in spread and control of this urban fire.
2. The Bayonne Civil Emergency Organization (Fire, police, CD, etc.) is geared to handle peacetime disasters at least as large as this industrial area fire.
3. Volunteer citizen help, working under the direction of trained personnel, was effective in handling hose during the emergency.
4. The amature radio club in Bayonne, operating from a tested plan that was developed to assist the Civil Defense organization in an emergency, provided valuable supplementary communication during the fire.
5. The command decision to sacrifice the heavily involved factories and protect critical exposures not yet involved was a significant step in successful control of the fire. An adequate communication and command system would be equally vital in controlling fire damage in nuclear war.
6. Drafting water from rivers, bays, or other salt water sources is standard procedure in the New Jersey — New York bay areas and provides a reliable source of supplementary water.

7. Failure of water pressure may render standpipes and normal water sources ineffective due to line ruptures and power failure in a nuclear attack.

8. Fire service training of industrial brigades has strengthened the overall level of fire protection in Bayonne.

9. Shelter fire guards could be effective in protecting shelter facilities that might otherwise be destroyed by fire.

10. The CD organization played an important supplementary role in traffic control, communications, and other emergency services. The Regional Coordinator was stationed at the Bayonne Fire Headquarters to fill requests for Civil Defense, supplies, and equipment.

11. Chief Momot, Chief Smith, and Director of Public Safety Hugh Greenan, recognized the role of their fire services in a nuclear attack to be (a) selective fire control with fallout monitoring, (b) seeking protection when necessary, and (c) followup fire control, rescue, and recovery when possible.

RECOMMENDATIONS

1. Develop a system, or utilize available systems, for rating shelter fire vulnerability of all shelter facilities.
2. Develop a fire protection plan for each shelter facility that would be workable during wartime emergencies. Consider type of equipment needed and how to accomplish the job on water availability, building and roof construction, and exposure to adjacent buildings.
3. Develop plans to integrate existing organized industrial fire brigades into an overall plan to cope with nuclear fires. (As an example, this might include specific assignments of trained firefighters to fallout shelter facilities needing protection.)
4. In all communities, continue to develop capability for using drafted water from bays, rivers, and lakes to handle both peacetime and wartime fire disasters.